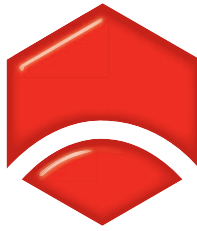


ENGINEERS AUSTRALIA

Western Australia Division



**ENGINEERS
AUSTRALIA**

CEREMONY REPORT

NORTH WEST SHELF PROJECT

GAS FIELDS OF PLENTY



Heritage Recognition Ceremony

**North West Shelf Project Visitors Centre
Burrup Road, Karratha, Western Australia**

2 August 2017

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Cover Photo – North Rankin A Platform
(Photo: Woodside HI - W0018-80.jpg)

1. Introduction

The North West Shelf (NWS) Project is Australia's first Liquefied Natural Gas (LNG) plant and was key to the development of Western Australia's 'gas fields of plenty'. The project is located both offshore with the North Rankin A platform and onshore with the Karratha Gas Plant. The North West Shelf project was awarded an Engineering Heritage International Marker (EHIM) during a dedication ceremony that took place on Wednesday 2 August 2017.

As an operating oil and gas plant, public access to the offshore platform or the onshore gas plant is not allowed. However the NWS Project has for many years provided a Visitors Centre on the Burrup Peninsula that overlooks the Karratha Gas Plant. The Visitors Centre was the location for the dedication ceremony and is the location for the EHIM and the Interpretation Panel.

The Visitors Centre is a two-hour plane trip or a 1,530 kilometre drive North of Perth. It is a popular tourist destination for 'grey nomads' during the winter months and is the appropriate location for the EHIM and the Interpretation Panel. As the Visitors Centre is also quite close to the location of the Interpretation Panel for the 'Pilbara Heavy Haul Railways', Engineering Heritage Australia now has two EHIM's and Interpretation Panels located on the Burrup Peninsula, Karratha.

2. Distinguished Guests and Invitations

To economise on travel arrangements, the date for the dedication ceremony was selected to coincide with a site visit by senior representatives of the six joint venture participants who own the NWS Project. James Westcott, the President of Engineers Australia Western Australia Division was also able to combine his trip with an annual visit to the West Pilbara Regional Group.

An invitation was extended to the Western Australian Minister for Heritage Hon David Templeman MLA, but unfortunately he had prior commitments. The role of representative for the community and distinguished guest for the unveiling of the Interpretation Panel was performed by Mr Kevin Michel MLA, Member for the Pilbara.

A list of invitees and a copy of the invitation are attached at Appendix 1. Invitations and acceptances were managed by Woodside and the WA Division office. Invitations were extended to Shire and Karratha industry representatives, as well as members of Engineers Australia West Pilbara Regional Group. Woodside also invited a number of senior operational staff located at the Karratha Gas Plant. Due to cost and other commitments, the only members of Engineering Heritage Western Australia and the team that drafted the nomination document that were able to attend were Ed Ryan and Mike Taylor.

3. Ceremony Program / Running Sheet

The dedication ceremony was organized by Woodside, who is the project operator on behalf of the NWS Project joint venture participants. The running sheet for the ceremony was as follows:

Times	Sequence	Comments
9.15 – 9.30 am	Guests arrive	Receive name tags and ceremony booklet
9.30 – 9.35 am	Acknowledgement of traditional ownership, welcome, recognition of distinguished guests, apologies and introduction of James Westcott.	Brian Haggerty Vice President Innovation Capability, Woodside
9.35 – 9.40 am	Engineers Australia Engineering Heritage Recognition Program	James Westcott, President Engineers Australia Western Australian Division
9.40 – 9.45 am	Significance of the NWS Project to the community of Western Australia	Kevin Michel MLA, Member for Pilbara.
9.45 – 9.50 am	Unveiling of Interpretation Panel and photographs	James Westcott, Kevin Michel Brad Russell-Lane
9.50 – 9.55 am	Acceptance of Engineering Heritage International Marker, importance of the development to the JV participants, acknowledgement of key people and thanks to Engineers Australia.	Brad Russell-Lane Vice President Australia Business Woodside
9.55 – 10.00 am	Closing remarks and thanks to retired employees who developed the nomination.	Brian Haggerty Vice President Innovation Capability, Woodside
10.00 – 10.30 am	Morning tea	

The Visitor Centre assisted with an easel for displaying the interpretation panel, a small table for the EHIM, a lectern, seating and the morning tea arrangements. Woodside provided a PVC copy of the interpretation panel, event photography, ceremony booklet and the nametags. EHWA provided an unveiling cloth, the EHIM mounted in a temporary stand and an EA banner for backdrop.

4. Speech Notes

The master of ceremonies was Mr Brian Haggerty, Vice President Innovation Capability, Woodside. Brian was also a member of the Engineers Australia Western Australia Division Committee.

Speeches were given by James Westcott, President Engineers Australia Western Australian Division, Mr Kevin Michel MLA and Mr Brad Russell-Lane, CEO North West Shelf. A copy of the speech delivered by Mr Westcott and the notes provided to Mr Michel MLA are attached at Appendix 2.

The audience was able to view the Karratha Gas Plant from the windows of the Visitors Centre during the ceremony.

5. Ceremony Booklet

A ceremony booklet was produced by Woodside in consultation with Mr Mike Taylor from the EHWA Committee, using material from the interpretation panel and the nomination document. Refer Appendix 3.

6. Media Articles

An article on the dedication ceremony was published by Engineers Australia in their electronic Australia wide newsletter on 30 October 2017. This article is on-line at <https://www.engineersaustralia.org.au/News/north-west-shelf-projects-global-impact>.

An article was also published by Woodside in their publically available 'Trunkline' magazine. The article is at pages 12 and 13 in the Q3 2017 edition. 'Trunkline is available at < <http://www.woodside.com.au/About-Us/trunkline/Documents/Trunkline%20Q3%202017.pdf#search=trunkline%20Q3%202017>>.

A copy of the two articles is available at Appendix 4.

7. Interpretation Panel and Marker Disc

The interpretation panel design is shown in Appendix 5. The panel and its steel frame were manufactured in accordance with Appendix G in the '2017 Guide to Engineering Heritage Recognition Program. The frame with the interpretation panel and the EHIM has been installed immediately outside the entrance to the NWS Project Visitors Centre in a prominent location overlooking the Karratha Gas Plant. A photo of the interpretation panel and marker disc installation and location is below.



Photo: Michael Bell, Engineers Australia, WA Division

8. Ceremony Photographs



Award of International Marker and unveiling of Interpretation Panel
James Westcott, Brad Russell-Lane and Kevin Michel MLA (Photo – Woodside)



Engineering Heritage Celebration by Engineers Australia and NWS Project
Ed Ryan, Brian Haggerty, Kevin Michel MLA, Brad Russell-Lane, Mike Taylor and
James Westcott (Photo – Woodside)

APPENDIX 1 – List of Invitees

NWS PROJECT - ENGINEERING HERITAGE AWARD CEREMONY - INVITATION LIST							
Title	First Name	Last Name	Category	Role	Organisation	Invited by	RSVP
Mr	Brian	Haggerty	Speaker MC	V/P Innovation Capability	Woodside	Woodside	Yes
Mr	Tim	O'Connor	NWS JV		BHPB	Woodside	Yes
Mr	Kevin	Stevenson	NWS JV		Chevron	Woodside	Yes
Mr	John	McArthur	NWS JV		MIMI	Woodside	Yes
Mr	Justin	Nash	NWS JV		BP	Woodside	Yes
Mr	Dave	Jillett	NWS JV		Shell	Woodside	Yes
Mr	Lewis	Lu	NWS JV		CNOOC	Woodside	Yes
Mr	Brad	Russell-Lane	NWS JV		Woodside	Woodside	Yes
Mr	Peter	Watkins	NWS JV		Woodside	Woodside	Yes
Mr	Dave	Sturgess	NWS JV		Woodside	Woodside	Yes
Mr	Andrew	Lobb	Woodside rep.		Woodside	Woodside	Yes
Ms	Jess	Farrell			Rio Tinto	Woodside	Yes
Mr	Kevin	Michel MLA	Government	Member for Pilbara	State Government	Woodside	Yes
Mr	Stuart	Bond	Woodside rep.			Woodside	Yes
Ms	Vanessa	Tran	Woodside rep.		Woodside	Woodside	Yes
Ms	Suzie	Cracknell	Woodside rep.		Woodside	Woodside	Yes
Ms	Danielle	East	Woodside rep.		Woodside	Woodside	Yes
Ms	Mandy	Alexander	Woodside rep.			Woodside	Yes
Mr	Peter	Long	Government	Mayor of City of Karratha	Local Government	Woodside	No
Mr	Keith	Cahill	Woodside rep.		Woodside	Woodside	Yes
Mr	Philip	Spiers			Woodside	Woodside	Yes
Mr	Hyon	Jik Yeo				Korea Gas	Yes
Mr	Ki	Hun Cho				Korea Gas	Yes
Mr	James	Westcott	Speaker EA	EAWA President	Engineers Aust.	EHA	Yes
Mrs	Karen	Riddette	EHWA Committee	EHWA Chair		EHA	No
Mr	Ian	Maitland	EHWA Committee	EHWA Vice Chair		EHA	
Mr	Mike	Taylor	EHWA Committee	EHWA Secretary		EHA	Yes
Prof	Mark	Bush	EHWA Committee	EHWA Member		EHA	No
Mr	Peter	Baxendale	EHWA Committee	EHWA Member		EHA	No
Mr	Bruce	James	EHWA Committee	EHWA Member		EHA	
Dr	David	Katz	EHWA Committee	EHWA Member		EHA	
Mr	Lloyd	Margetts	EHWA Committee	EHWA Member		EHA	No
Mr	Bob	Morrison	EHWA Committee	EHWA Member		EHA	No
Mr	Martin	Silk	EHWA Committee	EHWA Member		EHA	
Mr	Owen	Peake	EHA	Recognition Committee		EHA	No
Mr	Peter	Hopwood	EHWA NWS Team	Team Member		EHA	No
Mr	Bob	King	EHWA NWS Team	Team Member		EHA	No
Mr	Rob	Male	EHWA NWS Team	Team Member		EHA	No
Mr	Ed	Ryan	EHWA NWS Team	Team Member		EHA	Yes
Mr	Stan	Stroud	EHWA NWS Team	Team Member		EHA	No
Mr	Peter	Ellery	EHWA	Document Review		EHA	
Mr	David	Agostini	EHWA	Document Review		EHA	No
Dr	Errol	Seymour	EHWA			EHA	No
Mr	Dave	McDonald	EHWA			EHA	No
Mr	Bob	Armstrong	EHWA			EHA	
Mr	Jack	Watkins	EHWA			EHA	
Mr	Keith	Gammie	EHWA			EHA	No
Dr	Ray	Steedman	EHWA			EHA	
Ms	Joy	Pan	Representative	Oil & Gas EAWA Group	Engineers Aust.	EHA	Yes
Mr	Kieran	Dart	Chair	West Pilbara Group	Engineers Aust.	EHA	
Mr	John	Freimanis	Committee Member	West Pilbara Group	Engineers Aust.	EHA	No
Mr	Nathan	Hanrahan	Committee Member	West Pilbara Group	Engineers Aust.	EHA	Yes
Mr	Laxmikant	Jahagirdar	Committee Member	West Pilbara Group	Engineers Aust.	EHA	
Mr	Trevor	Kawadza	Committee Member	West Pilbara Group	Engineers Aust.	EHA	Yes
Mr	Sean	McCloughlin	Committee Member	West Pilbara Group	Engineers Aust.	EHA	No
Mr	Peicheng	Nie	Committee Member	West Pilbara Group	Engineers Aust.	EHA	Yes

Mrs	Storm	Nuttall	Committee Member	West Pilbara Group	Engineers Aust.	EHA	Yes
Mr	Yogesh	Pimpale	Committee Member	West Pilbara Group	Engineers Aust.	EHA	Yes
Mrs	Kylah	Morrison	BD Team	President	KDCCI	EHA	Yes
Mr	John	Lally	BD Team	CEO	KDCCI	EHA	Yes
Mr	Greg	Smith	BD Team	Planning Manager	Pilbara Ports	EHA	No
Mr	Alex	Cesa	BD Team	Engineering Student	Yara Pilbara	EHA	No
Mr	Dominic	Ball	BD Team	Project Coordinator	CADDs Group	EHA	Yes
Mr	Jared	Fitzclarence	BD Team	Managing Director	KAW Engineering	EHA	No

NORTH WEST SHELF PROJECT



ENGINEERING HERITAGE RECOGNITION AWARD CEREMONY

INVITATION

Mr Mike Taylor FIEAust CPEng(Ret)

Engineers Australia and the North West Shelf Project participants are pleased to invite you to attend a ceremony to celebrate the award of an Engineering Heritage International Marker to the North West Shelf Project (Phases 1 and 2).

WHERE

NWS Project Visitors Centre
Burrup Road, Karratha WA

REFRESHMENTS

Morning tea will be served
following the Ceremony

WHEN

Wednesday, 2 August 2017

RSVP

For planning purposes, please RSVP by email before Wednesday, 26 July 2017 to: SMantle@engineersaustralia.org.au
(For name tags at the event, please advise your preferred name)

TIME

Arrive 9.15 am for a 9.30 am start

Enquiries: Sharleen Mantle Ph. (08) 6214 6305 or Vanessa Tran Ph. (08) 9348 4011

North West Shelf Project



ENGINEERS
AUSTRALIA

BHP



APPENDIX 2 – Speech Notes

Speech by Mr James Westcott, President WA Division, Engineers Australia

Mr Kevin Michel MLA, Member for Pilbara representing the Karratha and Western Australian community, Mr Brad Russel-Lane representing our hosts the North West Shelf Project Participants, distinguished guests, ladies and gentlemen.

As President of Engineers Australia Western Australia Division, it was with great pleasure that I accepted the invitation from Engineering Heritage WA to take part in this commemoration ceremony for the award of an Engineering Heritage International Marker to the North West Shelf Project (Phases 1 & 2). These phases were the pioneering phases that commenced with preliminary engineering in 1978 and achieved first shipment of LNG in 1989.

Engineers Australia is the peak professional institution for engineers and has more than 100,000 members. Engineering heritage is one of many programs supported by Engineers Australia. There are groups of engineering heritage volunteers in every State and Territory, supported by a national centre titled Engineering Heritage Australia. A long running national initiative is the Engineering Heritage Recognition Program. This program has three levels of award with today's award of an Engineering Heritage International Marker being the highest level for special significance on an international scale.

The Engineering Heritage Recognition Program commenced in 1984 and ceremonies like today's have been occurring for more than 30 years. More than 200 sites and structures have been recognised to date, located in every State and Territory and covering virtually all aspects of Australia's engineering heritage, including:

- Ports, Railways, Roads, Bridges and other aspects of transport;
- Dams, Pipelines, Pumping Stations required for water supply;
- Power Stations for electricity supply;
- Engineering Innovations; and
- Military Engineering including the Woomera Rocket Range and Jindalee Over-the-horizon Radar.

Today's recognition is the Program's first award in the oil and gas industry. Here in Western Australia, including today's recognition of the North West Shelf, a total of 26 sites have been recognised. The most notable of these is the Goldfields Water Supply, which in 2009 was also awarded an American Society of Civil Engineers International Landmark.

Recent sites recognised in Western Australia include:

- The NASA Space Tracking Station at Carnarvon, a joint American Australian facility which played a key role in the 1969 moon landing;
- The Fremantle Fortress – Leighton Battery World War 2 Coastal Defence Facilities;
- Stirling Bridge across the Swan River at Fremantle, reflecting developments in precast concrete segments and post tensioning;

- Sons of Gwalia – Headframe and Winder Engine, key components of Western Australia’s gold mining history; and
- Pilbara Heavy Haul Railways, without which the Pilbara’s iron ore industry would not be possible. (The marker and interpretation panel for this award is just down the road at Rio’s lookout on Parker Point Road, just before you enter Dampier town site)

Before award of an Engineering Heritage marker, a nomination document providing information on the site’s history and significance is prepared. These nomination documents are available from the Engineers Australia website and provide an invaluable record of Australia’s engineering achievements. When a site is approved for recognition, an interpretation panel that provides an introduction as to the significance of the site is designed and installed at a suitable location for visitors to read.

The nomination document for the North West Shelf Project is especially valuable as it was written by a team of retired engineers who worked on the Project, and as such includes their knowledge and insight. Engineering Heritage WA thanks these engineers for their efforts. Completion of the nomination document, the Interpretation panel and to-days ceremony would not be possible without the support of the North West Shelf Project through Woodside and on behalf of Engineers Australia, I thank the Project Participants for their support.

The story of the North West Shelf Project and Western Australia’s oil and gas industry is not yet complete. However, there is no doubt that the pioneering phases of the North West Shelf Project were internationally significant and the North West Shelf Project is a worthy addition to the list of Australian engineering heritage projects.

Notes provided to Mr Kevin Michel MLA, Member for Pilbara

Purpose: Ceremony to celebrate the award by Engineers Australia of an Engineering Heritage International Marker to the North West Shelf Project (Phases 1 and 2) and the unveiling of an Interpretation Panel.

Timing: 9.30 am Wednesday 2 August 2017.

Location: NWS Visitors Centre, Burrup Road, Karratha.

Attached: Program (running sheet) provided to all speakers;
List of attendees;
Speech for James Westcott, Engineers Australia;
Copy of the Interpretation Panel;
Western Australian Statistics Digest; and
Australia's Top 25 Goods & Services exports.

Notes: The MC is Mr Brian Haggerty from Woodside, who is also a member of the Engineers Australia WA Division Committee.

At the end of Kevin Michel's speech, he will be joined by James Westcott and Brad Russell-Lane. It would be appreciated if Kevin Michel could perform the unveiling of the Interpretation Panel and join James and Brad for photographs.

Background: This event is timed to be part of the program arranged for the annual visit to the Burrup by senior representatives of the NWS Project Participants. Kevin may wish to welcome the BHPB, Chevron, MIMI, BP, Shell, CNOOC and Woodside representatives and thank them for their continuing support for this important Western Australian domestic gas and LNG export facility.

Engineers Australia and the North West Shelf Project want the public, and in particular the Karratha community, to be aware of this award. In participating in this ceremony, Kevin as the Member for Pilbara is representing the community and assisting in this awareness.

Speech: It is suggest that the focus of Kevin's five-minute speech be on the importance of the North West Shelf Project to Karratha and Western Australia, concluding with congratulations to the North West Shelf Project Participants on being awarded an Engineering Heritage International Marker.

For Karratha, which originally developed on the iron ore and salt industries, the North West Shelf brought a whole new dimension that now includes multiple platforms offshore support, the Pluto plant and Yara Pilbara Fertilisers. Recognising the significance of the gas industry, Karratha's annual festival (which is on the coming weekend) has had a name change to the FENACLNG Festival.

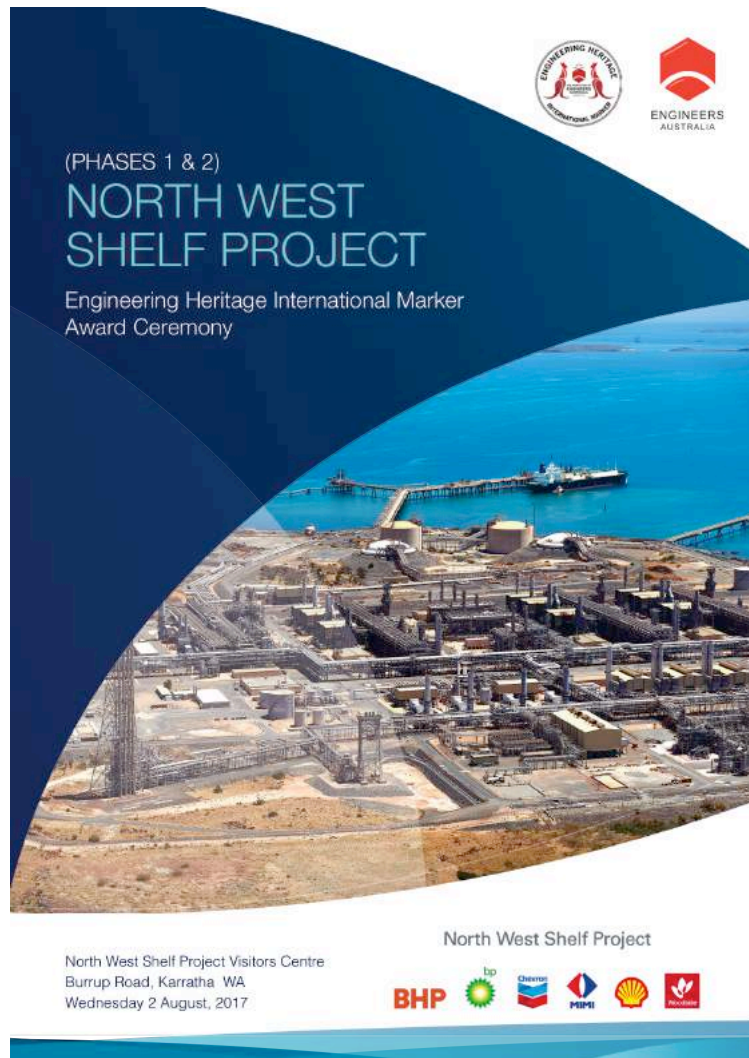
For Western Australia, the North West Shelf was the pioneering development that led to a whole new industry in Australia. While there were previous oil and gas developments in the Eastern States, Bass Straight in particular, the North West Shelf Project was on a whole new scale in size and technical complexity and is Australia's first LNG export facility.

Natural gas through the Dampier to Bunbury has been key to maintaining Western Australia's industrial capacity, particularly bauxite refining and power generation.

LNG, crude oil and condensate were Western Australia's second largest resource in 2015-16, 50% larger than the gold industry and three times the value of the Alumina industry. On a national scale, natural gas and crude petroleum is now Australia's 4th largest export after iron ore, coal and education.

(See attached extracts from WA Mineral and Petroleum Statistics Digest and Australian Government top 25 goods & services exports)

APPENDIX 3 – Ceremony Booklet



PROGRAM

Brian Haggerty

Vice President Innovation Capability, Woodside

*Acknowledgement of Traditional Ownership of Land, formal
welcome, recognition of distinguished guests and apologies.*

James Westcott

President of Engineers Australia Western Australian Division

*Engineers Australia Engineering Heritage Recognition Program
and award of the Engineering Heritage International Marker.*

Mr Kevin Michel MLA

Member for Pilbara

*Significance of the North West Shelf Project to the community of
Western Australia.*

Unveiling of Engineering Heritage Australia Interpretation Panel

Brad Russell-Lane

CEO North West Shelf

Acceptance of Engineering Heritage International Marker.

Brian Haggerty

Vice President Innovation Capability, Woodside

Closing remarks.

*The Ceremony will be followed by a morning tea served in the
North West Shelf Project Visitors Centre*

NORTH WEST SHELF PROJECT (PHASES 1 & 2)

History

The North Rankin, Goodwyn and Angel gas fields were discovered in 1971 and 1972. These gas fields are located 130 kilometres north-west of Dampier in 125 metre water depth. The technical and engineering challenges facing development of these remote gas fields were significantly greater than anything faced by earlier offshore developments in Australia. Only the creation of a new Australian Liquefied Natural Gas (LNG) export industry could make the development of these large gas fields economically viable.

Phase 1 of the North West Shelf (NWS) Project was constructed between 1980 and 1984. This phase included the North Rankin A offshore drilling and production platform, a large one metre diameter submarine pipeline from the platform to the Burnup Peninsula, the King Bay Support Facility, the Karratha Gas Plant and facilities for export of residual condensate. In parallel with Phase 1, the Western Australian Government constructed the 1,530 kilometre long Dampier to Bunbury Natural Gas Pipeline. Phase 2, constructed between 1985 and 1989, included two LNG processing trains, storage tanks, export wharf facilities and six LNG tankers.

With Phase 1 and 2 investments of \$7.1 billion and a total investment of more than \$34 billion since the late 1970s, the NWS Project is one of the largest resource development projects in Australian history. At the time of construction, it was the largest engineering project underway worldwide in the oil and gas industry. Including additional phases, current capacity of the NWS Project is 46,000 tonnes per day of LNG for export, 12,600 tonnes per day of gas for Western Australia and 10,000 tonnes per day of condensate. Present day capacity is now four times larger compared to Phase 2 capacity in 1989.

ACHIEVEMENTS

Significant achievements during Phases 1 and 2 include:

- development of new information for the Pilbara and offshore region on meteorology, cyclones, ocean currents, seabed foundation materials and topography;
- planning, design and construction of the largest capacity offshore gas and condensate platform in the world at that time;
- introducing a step change for LNG plant design from seawater-cooled to air-cooled facilities and from steam turbines to gas turbines;
- overcoming foundation problems associated with the carbonate sediments encountered on the North West Shelf and sharing this experience with industry;
- development of new design criteria and operational procedures for the transfer of both liquids and gas through the single submarine pipeline from North Rankin A platform;
- demonstration of a new standard for Australia in the management of safety and quality throughout all stages of the NWS Project;
- establishment of long-term domestic gas supply and LNG export contracts; and
- cementing the NWS Project's reputation as a reliable provider of domestic gas and exporter.

PROJECT DATA

Project name	North West Shelf Project (NWS Project) – Phases 1 and 2
Owners	<p>Domestic Gas Project – Phase 1</p> <p>North West Shelf Gas Pty Ltd ("NWSGPL") oversees the domestic gas marketing activities of the project.</p> <p>NWS LNG Project – Phase 2</p> <ul style="list-style-type: none"> The six participants in the NWS Project are: BHP Billiton Petroleum (North West Shelf) Pty Ltd BP Developments Australia Pty Ltd Chevron Australia Pty Ltd Japan Australia LNG (MIM) Pty Ltd Shell Australia Pty Ltd Woodside Energy Pty Ltd (Woodside) <p>CNOOC is also a participant in the NWS Project but does not have an interest in its asset infrastructure.</p> <p>Woodside is the project operator of both ventures on behalf of the other participants.</p>
Current use	<ol style="list-style-type: none"> Export of up to 16.9 Mtpa (46,000 tonnes per day) of LNG predominantly to Asia. Supply of pipeline specification natural gas into the Dampier to Bunbury Natural Gas Pipeline to the south-west of Western Australia at a rate of up to 12,600 tonnes per day. Export of condensate at the rate of up to 10,000 tonnes per day. Export of LPG at an average rate of 1,500 tonnes per day.
Designer	Various. Managed by Woodside with technical advice from Royal Dutch Shell.
Builder	Many thousands of people contributed to the development of the NWS Project. There were hundreds of contractors and suppliers and a list of contracts valued at \$20 million and over is available in Woodside's publication titled 'Beyond the Flame', page 134.

Year started	<p>1971 – Offshore hydrocarbon discovery at North Rankin</p> <p>1978/9/80 – Preliminary engineering – Phase 1 works</p> <p>1980/84 – Detailed engineering and construction – Phase 1</p> <p>1985/89 – Detailed engineering and construction – Phase 2</p>
Year completed	<p>Phase 1 – 1984</p> <p>Phase 2 – 1989</p> <p>Phase 3 – 1993</p> <p>Phase 4 – 1999</p> <p>Phase 5 – 2008</p>
Physical description	<p>Phase 1 – Domestic gas</p> <ul style="list-style-type: none"> Initial offshore production platform ("NRA") located over the North Rankin Field. Pipeline from NRA to shore near Withnell Bay in Mermaid Sound. Onshore production facilities to provide pipeline specification gas for the Western Australian market. Condensate storage and export facilities. Offshore supply base and tug pens at King Bay and an adjacent materials offloading facility to support onshore construction together with general cargo and fuel imports. Housing and other facilities in Karratha for Woodside personnel during the construction and operations phases. <p>Phase 2 – LNG export</p> <ul style="list-style-type: none"> Two LNG production trains for LNG export at the Karratha Gas Plant. Storage and export facilities for LNG. Six LNG carriers.
Modifications and dates	<p>1992 Modification of LNG trains 1 and 2 to improve production rates to 2.5 Mt per year each (aggregate total 5 Mtpa).</p> <p>1993 Addition of a 3rd LNG production train at a rate of 2.5 Mt per year (7.5 Mtpa).</p> <p>1995 Addition of a 2nd offshore production facility over the Goodwyn Field (GWA).</p> <p>1995 Installation of Cossack Pioneer FPSO over Wanaea-Cossack fields with oil production of 6 kt per day.</p>

Modifications and dates	1996	Addition of a LPG plant, storage and export facilities at Withnell Bay.
	2004	Addition of a 4th LNG production train at a rate of 4.4 Mt per year (11.9 Mtpa).
	2004	Installation of second parallel pipeline from NRA to Withnell Bay.
	2008	Addition of a 5th LNG production train at a rate of 4.4 Mt per year (16.3 Mtpa).
	2009	Installation of 3rd platform at Angel location and pipeline to NRA.
	2011	Replacement of Cossack Pioneer FPSO with Okha FPSO with heavy gas pipeline to NRA.
	2013	Completion of the North Rankin Redevelopment Project including installation of NRB platform adjacent to and bridge- connected to NRA.
	2015	First production from the Greater Western Flank Phase 1 Project.
Engineering Excellence awards	1990	The North Rankin A Platform Foundations Project was awarded the inaugural Sir William Hudson Award for the best engineering project in Australia.
	1992	The Trunkline Remedial Stabilisation Project was awarded a WA engineering excellence award.
	1993	The Remote Offshore Warning System was awarded a WA engineering excellence award and the Pipeline Emergency Isolation System was highly commended.
	1994	Both the Goodwyn A platform remedial works and the North Rankin reliability upgrade were awarded WA engineering excellence awards.
	2015	The North Rankin Redevelopment Project was awarded a WA engineering excellence award.



APPENDIX 4 – Media Articles

Engineers Australia News, Monday, 30 October 2017

North West Shelf Project's global impact

Australia's entry into the LNG industry was pioneered by the North West Shelf Project



Engineers Australia has acknowledged the significance of the North West Shelf Project with the award on 2 August 2017 of a prestigious Engineering Heritage International Marker.

The West Australian President, James Westcott said that the International Marker is Engineering Heritage's highest award and recognises the North West Shelf Project's global impact.

"The award is for the Project's phases one and two which were the pioneering stages, spanning the period from 1978 to 1989. This included Australia's first shipment of LNG or liquefied natural gas," Mr Westcott said.

Member for Pilbara, Mr Kevin Michel MLA said the significance of the North West Shelf Project to the community was immense.

"In Karratha, natural gas from the North West Shelf Project has joined the iron ore and salt industries in providing employment and community infrastructure.

"At a State level, natural gas supplied through the Dampier to Bunbury pipeline has been a major source of energy for WA's households and industries.

"Australia's entry into the LNG industry was pioneered by the North West Shelf Project and including associated petroleum production, this industry is now Australia's third largest export by value," Mr Michel said.

Phases one and two of the Project included construction of North Rankin A, the largest capacity gas platform in the world at that time; and the introduction of air cooling and gas turbines for LNG production.

Other achievements included the development of new procedures for the transfer of both liquids and gas through a single 130 kilometre long submarine pipeline.

Recognition of the North West Shelf Project would not have been possible without the contribution from engineers who worked on the Project in the 1980's. One of those engineers Mr Bob King, project manager for installation of the North Rankin platform, commented:

"The possibility of recognition under the engineering heritage recognition program provided the impetus and opportunity for engineers involved in the North West Shelf Project to work again cooperatively and identify the real engineering challenges and accrued benefits of this frontier project."

Management of the nomination on behalf of Engineering Heritage WA was Mr Mike Taylor. Mr Taylor said accessing engineering information on major infrastructure built since the privatisation changes in the mid 1990's can no longer be taken for granted.

"Traditionally Australia's infrastructure was provided by Government with important information, including engineering plans and reports, being deposited in State and National archives", Mr Taylor said.

"With much of Australia's infrastructure now owned by Companies and designed by various engineering consultancies, there is no mechanism for engineering information to be available to future researchers.

"Similar to the North West Shelf Project, we should not leave it too late to document our achievements."

North West Shelf CEO, Brad Russell-Lane, accepted the Engineering Heritage International Marker.

The North West Shelf Project is only the third project in WA to receive an Engineering Heritage International Marker. The first was the NASA Space Tracking Station at Carnarvon and the second was Rio Tinto's Pilbara heavy-haul railways.

Image: Aerial view of the Karratha Gas Plant, courtesy of Woodside.

Gas fields of plenty

Long before mobile phones, Google, 3D modelling and the resources "boom", a bunch of determined engineers with unprecedented vision set out to turn an isolated, frontier area of Australia into an internationally significant industry hub.

Not only were their ambitions fulfilled but their legacy continues to shape Australia's energy future.

And now their ground-breaking engineering achievements that emerged in the pioneering development stage have been recognised by Engineers Australia, the body representative of more than 100,000 engineers across the country.

Engineers Australia awarded the North West Shelf (NWS) Project Phases 1 and 2 with its Engineering Heritage International Marker.

"The project has special international significance," said James Westcott, president of Engineers Australia's WA branch.

And Mr Westcott, who presented the award to representatives of the NWS participants in Karratha in August, told attendees at the award ceremony that it was "the first oil and gas project awarded in a program that has been going since 1984".

The international marker is the highest category for the award and places the NWS Project into a peer group with the iconic Snowy Mountains Scheme,

Sydney Harbour Bridge, and the Goldfields Water Supply Scheme.

During the initial construction phase in the 1980s, it was the largest engineering project underway worldwide in the oil and gas industry, and the largest single non-government project ever undertaken in Australian history.

Brian Haggerty, vice president innovation and capability, was one of the Woodsiders who attended the ceremony.

"I remember standing on the beach, putting my foot in the sand, and saying the 'pipe will come through here'," he recalled.

The Burrup Peninsula was then remote, rocky and undeveloped.

Many thousands of people contributed to the development of the NWS Project and Brad Russell-Lane, vice president Australia Business, paid tribute to them on receiving the award on behalf of the NWS participants.

"It's a project that built Australia's reputation for reliable LNG supply, establishing a lot of firsts," said Brad, who once worked as a graduate on the North West Shelf developments. "It is the relentless pursuit in the face of challenge that defined and continues to define the Project."

The list of firsts that Brad mentioned is impressive.

It includes the largest capacity offshore gas and condensate platform in the world at the time, and North Rankin continues to be one of the world's largest.

Other firsts represented innovations and significant step-outs from then global practice, such as converting from traditional water cooled to air-cooled LNG plant design. That innovation both improved the project's capital costs and environmental footprint.

"The NWS brought a new dimension to industry in the Pilbara," said Kevin Michel, the State Member of Parliament for the Pilbara.

Mr Michel congratulated the NWS Project on "reaching beyond the region, and creating many, many jobs".

It is estimated that the NWS Project directly injects more than \$900 million a year directly into the nation's economy, through a combination of its expenditures and taxes contributed.

The NWS participants commended the impressive pioneering spirit to undertake this project at the infancy of computer power and in the vast remoteness of Australia's north west.

Required to operate in a wide range of weather conditions with a high level of safety and reliability, the project utilised leading edge international technology and engineering practice in design and construction.



1978

State Agreement for NWS Project



1980

Domestic Gas Purchase Agreement
Commence On-shore Site Preparations





Marking time: (above) Pilbara State MP Kevin Michel was the guest of Karratha Gas Plant to unveil the Engineering Heritage International Marker. Engineers Australia awarded the Marker to the North West Shelf Project Phases 1 and 2; (below) early days on the Burrup Peninsula.

"It was just new," said Brian.

"By just going out and doing it, we created a huge business."

Clearly proud of the achievements that the award recognises, Brian strongly encourages everyone to take inspiration from the past but also to look forward.

"The world's changing quickly and we can take advantage of it," he says.

A plaque commemorating the "Gas Fields of Plenty" award was unveiled at the NWS Visitors Centre at the Burrup. There it will testify these great engineering achievements and perhaps inspire the hundreds of daily visitors, young and old.

Fast Facts

- Largest capacity offshore gas and condensate platform in the world at the time, located 135km northwest of Karratha in 125m of water.
- Largest two-phase flow subsea pipeline system to operate globally.
- First 'tuned' ocean wave array to predict cyclone generated wave heights in Mermaid Sound.
- First air cooled (not water cooled) LNG Train.
- World's largest cutter-suction dredge employed in Mermaid Sound.



1982

Installation of North Rankin A Platform



1984

First Domestic Gas Delivery



1989

First LNG Delivery

APPENDIX 5 – Interpretation Panel



GAS FIELDS OF PLENTY NORTH WEST SHELF PROJECT (PHASES 1 & 2)

History

The North Rankin, Goodwyn and Angel gas fields were discovered in 1971 and 1972. These gas fields are located 130 kilometres north-west of Dampier in 125 metre water depth. The technical and engineering challenges facing development of these remote gas fields were significantly greater than anything faced by earlier offshore developments in Australia. Only the creation of a new Australian Liquefied Natural Gas (LNG) export industry could make the development of these large gas fields economically viable.

Phase 1 of the North West Shelf (NWS) Project was constructed between 1980 and 1984. This phase included the North Rankin A offshore drilling and production platform, a large one metre diameter submarine pipeline from the platform to the Burrup Peninsula, the King Bay Support Facility, the Karratha Gas Plant and facilities for export of residual condensate. In parallel with Phase 1, the Western Australian Government constructed the 1,530 kilometre long Dampier to Bunbury Natural Gas Pipeline. Phase 2, constructed between 1985 and 1989, included two LNG processing trains, storage tanks, export wharf facilities and six LNG tankers.

With Phase 1 and 2 investments of \$7.1 billion and a total investment of more than \$34 billion since the late 1970s, the NWS Project is one of the largest resource development projects in Australian history. At the time of construction, it was the largest engineering project underway worldwide in the oil and gas industry. Including additional phases, current capacity of the NWS Project is 46,000 tonnes per day of LNG for export, 12,600 tonnes per day of gas for Western Australia and 10,000 tonnes per day of condensate. Present day capacity is now four times larger compared to Phase 2 capacity in 1989.



Karratha Gas Plant under construction



LNG and condensate loading wharves



North Rankin platform under construction

Achievements

Significant achievements during Phases 1 and 2 include:

- development of new information for the Pilbara and offshore region on meteorology, cyclones, ocean currents, seabed foundation materials and topography;
- planning, design and construction of the largest capacity offshore gas and condensate platform in the world at that time;
- introducing a step change for LNG plant design from seawater-cooled to air-cooled facilities and from steam turbines to gas turbines;
- overcoming foundation problems associated with the carbonate sediments encountered on the North West Shelf and sharing this experience with industry;
- development of new design criteria and operational procedures for the transfer of both liquids and gas through the single submarine pipeline from North Rankin A platform;
- demonstration of a new standard for Australia in the management of safety and quality throughout all stages of the NWS Project;
- establishment of long-term domestic gas supply and LNG export contracts; and
- cementing the NWS Project's reputation as a reliable provider of domestic gas and exporter of LNG.

Project Impacts

In addition to construction on the Burrup Peninsula, local impacts included significant contributions to Government infrastructure, employee housing and other community facilities in Karratha.

At the state level, the NWS Project helped establish new industries in Western Australia including initial development of the area in Cockburn Sound that has become the Australian Marine Complex. The NWS Project also supports Western Australian universities' participation in world-class industrial research in the areas of oil and gas processing, oceanography and offshore foundation design.

The NWS Project has driven long-term economic benefits at a national level. To date, it has contributed in excess of \$26 billion in royalties and continues to inject more than \$900 million a year directly into the Australian economy.

Key People

There were many people from the project's joint venture participants and the State Government who supported the NWS Project between gas discovery in 1971 to first shipment of LNG to Japan in 1989. Some of the key individuals include:

- Geoff Donaldson, Chairman Woodside (1956 – 1984);
- Charles Allen, Woodside Chief Executive and Managing Director (1980 – 1996);
- Peter Tapper, Woodside Executive General Manager (1982 – 1990);
- Sir Charles Court, Premier Western Australia (1974 – 1982); and
- Peter Jones, Minister for Resources Development (1980 – 1983).

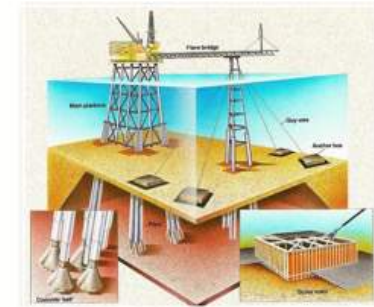
Engineers from Woodside, Shell and various contractors had to overcome the significant technical and engineering challenges faced by the project. The NWS Project would not have been possible without their ingenuity and leading international practice.

Engineering Excellence

In 1990, Engineer's Australia awarded the North Rankin A Platform Foundations Project the Sir William Hudson Award for the best engineering project in Australia. Other aspects of the NWS Project have also been awarded Western Australia Engineering Excellence Awards.



Sir Charles Court and Project participants announcing domestic gas project



North Rankin A Platform foundation remedial programme



North West Shelf Project Phase 1 and 2 layout



Overview of North West Shelf Project today

North West Shelf Project



The China National Offshore Oil Corporation is also a participant in the Project but does not have an interest in the infrastructure.



An Engineering Heritage International Marker was awarded to the North West Shelf Project (Phases 1 and 2) by Engineering Heritage Australia on 2 August 2017.

Engineers Australia thanks Woodside Energy for their help in producing this interpretation panel and for providing photographs.



For more details of this and other engineering heritage awards, go to www.engineeringheritage.com.au



For more details of the North West Shelf Project, go to www.woodside.com.au